Typical Cost Estimates



M-0446 Ramp Metering Feasibility Study for Durham and Wake Counties

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Introduction

This report presents typical ramp metering cost estimates for various alternative and optional features. The document describes the assumptions and unit costs used to develop the typical site costs.

For each typical ramp meter configuration, this report includes the site-specific capital costs associated with the following:

- Geometric construction
- Signal displays and supports
- Detection
- Controllers
- Signing
- Pavement markings

Separately, the report includes program costs—procurement and integration of the control software and the controller firmware, which are prorated per site. Training costs are included in the software costs as described in this report. Operations and maintenance costs have been estimated using information from other states.

These planning-level estimates will be used in the development of the Implementation Plan. The cost for a specific location will be developed from the typical cost estimate and customized for any site-specific conditions present at the location. Please note that these are general costs derived for the purpose of this study. Actual costs will vary based on the actual design and implementation of a ramp meter.

The Appendix contains the typical drawings from the Task 7 Typical Design Criteria Report, as well as additional detail of each cost category for each typical layout.

1. Typical Cost Methodology

Capital cost estimates are included for six basic ramp meter configurations. The costs of the following alternatives are presented in this report:

- Single-Lane Ramp Meter
- Single-Lane Ramp Meter (Loop Ramp)
- Two-Lane Ramp Meter
- Single-Lane Ramp Meter with Transit Bypass Lane
- Single-Lane Freeway-to-Freeway Ramp Meter
- Two-Lane Freeway-to-Freeway Ramp Meter

In addition, a separate capital cost estimate for optional enforcement features is included in this report. Each of the two optional features presented can be applied individually or together to any of the six basic ramp meter configurations. The optional enforcement features are: :

- Paved enforcement area
- Enforcement light

For each alternative, quantity estimates were made for each item of work. For each of these items of work, a planning level unit cost was applied, using NCDOT historical unit costs as a basis. In some cases, vendor quotes and data from other state DOTs were used. For each alternative, costs were applied for engineering design, traffic control, construction inspection, administration, and contingencies.

1.1. General Assumptions

For each estimate, certain basic assumptions must be made to produce a "typical" or generic cost estimate. When site-specific costs are developed, these assumptions will be refined on a site-by-site basis. Assumed quantities are shown in the tables documenting each alternative's costs.

For each alternative the following basic design assumptions were made:

- Ramp meter controllers will be protected by guardrail by placing the controller behind either existing or new guardrail. Each site's needs will be evaluated in the implementation plan.
- Where trunk fiber-optic communications to the State Traffic Operations Center (STOC)
 is assumed to exist along the corridor, drop cables are included in the costs from the
 trunk cable to the ramp meter site.
- Ramp detection, which uses inductive loops on the ramp, is shown in Figure C-1 and C-2. For two-lane ramp meters, the same detection layout is used in each lane.
- Mainline detection on the ramp is shown in Figure C-3. The upstream freeway detection site is assumed to be microwave detection with wireless (radio) communications to the ramp meter controller cabinet.
- Non-freeway-to-freeway signing and pavement markings are shown in Figures D-1 and D-2.

- Freeway-to-freeway signing and pavement markings are shown in Figure D-3.
- Non-freeway-to-freeway ramps are assumed to have a 40-mph design speed. For loop ramps, a design speed of 30 mph is assumed. Based upon AASHTO standards, the formula for calculating taper length is:

 $L = WS^2/60$ where L = taper length in feet, W is the transition width in feet, S is the speed in mph.

• Freeway-to-freeway ramps are assumed to have a 50-mph design speed. Based upon AASHTO standards, the formula for calculating taper length is:

L = WS
where L = taper length in feet,
W is the transition width in feet,
S is the speed in mph.

1.2. Single-Lane Ramp Meter

The geometric layout of the single-lane ramp meter alternative is shown in Figure A-1. This alternative assumes there is no pavement widening, that the typical 16-foot-wide ramp lane is narrowed to 12 feet, and that 12 foot width is maintained for 100 feet upstream of the ramp meter. The transition tapers are 110 feet long for a 40-mph design speed.

Signal heads are pedestal-mounted with breakaway pedestals. Guardrail with approach end treatment on one side of the ramp is included to protect the ramp meter cabinet and pedestal pole.

For the single-lane ramp meter typical layout, costs are estimated as shown in Table 1.

Table 1. Typical Single-Lane Ramp Meter Construction Costs

Categories			otal Cost
Earthwork and Structures		\$	3,998
Guardrail		\$	5,250
Drainage		\$	-
Signalization		\$	58,307
Communications		\$	7,400
Pavement Marking		\$	1,089
Signing		\$	2,300
Subtotal Construction (rounded)		\$	78,350
Traffic Control	3%	\$	3,000
Contingencies	10%	\$	8,000
Construction (rounded)		\$	89,350
Design	8%	\$	8,000
Construction Administration 10%		\$	9,000
Total Design and Construction		\$	106,350

1.3. Single-Lane Loop Ramp Meter

The geometric layout of the loop ramp alternative is shown in Figure D-2. The ramp meter on a loop ramp varies from the single-lane alternative in the layout of advance signing and marking, due to the lower design speed and possible restricted sight distance.

This alternative assumes there is no pavement widening, that the typical 16-foot-wide ramp lane is narrowed to 12 feet, and that 12 foot width is maintained for 100 feet upstream of the ramp meter. The transition tapers are 60 feet long for a 30-mph design speed.

Signal heads are pedestal-mounted with breakaway pedestals. Guardrail with approach end treatment on one side of the ramp is included to protect the ramp meter cabinet and pedestal pole.

For the single-lane loop ramp typical meter layout, the costs are estimated as shown in Table 2.

Table 2. Typical Single-Lane Loop Ramp Meter Construction Costs

Categories			otal Cost
Earthwork and Structures		\$	3,998
Guardrail	Guardrail		5,250
Drainage		\$	-
Signalization		\$	58,307
Communications		\$	7,400
Pavement Marking		\$	775
Signing		\$	2,300
Subtotal Construction (rounded)		\$	78,030
Traffic Control	3%	\$	3,000
Contingencies	10%	\$	8,000
Construction (rounded)		\$	89,030
Design	8%	\$	8,000
Construction Administration	10%	\$	9,000
Total Design and Construction		\$	106,030

1.4. Two-Lane Ramp Meter

The geometric layout of this alternative is shown in Figure A-2. It is assumed the existing ramp has a 16-foot lane, so widening would be necessary (although it is a site-specific issue). For this report, it is assumed an existing 16-foot ramp with 4-foot paved shoulders will be widened to two 12-foot lanes with 4-foot paved shoulders. The total pavement width will be 32 feet, which results in a net of 8 feet of total widening, or 4 feet on each side of the existing ramp. The transition tapers are 110 feet long for symmetrical widening and a 40-mph design speed.

The ramp detection layout will use the same configuration in each lane as a single-lane ramp. Signal heads are pedestal-mounted with breakaway pedestals. Guardrail with approach end treatment on both sides of the ramp is included to protect the ramp meter cabinet and both pedestal poles.

For the two-lane ramp typical meter layout, the costs are estimated as shown in Table 3.

Table 3. Typical Two-Lane Ramp Meter Construction Costs

Categories			otal Cost
Earthwork and Structures		\$	4,065
Guardrail		\$	10,500
Paving		\$	15,664
Drainage		\$	-
Signalization		\$	61,778
Communications		\$	7,400
Pavement Marking		\$	1,149
Signing		\$	2,950
Subtotal Construction (rounded)		\$	103,510
Traffic Control	3%	\$	4,000
Contingencies	10%	\$	11,000
Construction (rounded)		\$	118,510
Design	8%	\$	10,000
Construction Administration	10%	\$	12,000
Total Design and Construction			140,510

1.5. Single-Lane Ramp Meter with Transit Bypass Lane

The geometric layout of this alternative is shown in Figure A-3. To ensure drivers stay in their respective lanes, a 4-foot traffic separator between the lanes is required.

It is assumed the existing ramp has a 16-foot lane, so widening would likely be necessary (although it is a site-specific issue). It is further assumed an existing 16-foot ramp with 4-foot paved shoulders will be widened to two 12-foot lanes, 4-foot paved shoulders, and 4-foot traffic separator. There will be 1 foot between the traffic separator and each driving lane. The total pavement width is 38 feet, which results in a net of 14 feet of total widening, or 7 feet on each side of the existing ramp. The transition tapers are 190 feet long for symmetrical widening and a 40-mph design speed.

This alternative also differs from a single-lane ramp meter by having a different detection scheme in the second, or bypass, lane as shown in Figure C-2.

Guardrail with approach end treatment on both sides of the ramp is included to protect the ramp meter cabinet and both pedestal poles. Additional signing for the bypass lane and some changes in the pavement markings will be necessary.

For the single-lane ramp meter with transit bypass typical layout, the costs are estimated as shown in Table 4.

Table 4. Typical Single-Lane Ramp Meter with Transit Bypass Construction Costs

Categories			otal Cost
Earthwork and Structures	Earthwork and Structures		4,400
Guardrail		\$	10,500
Paving		\$	33,812
Drainage		\$	-
Signalization		\$	60,216
Communications		\$	7,400
Pavement Marking		\$	3,567
Signing		\$	3,850
Subtotal Construction (rounded)			123,750
Traffic Control	3%	\$	4,000
Contingencies	10%	\$	13,000
Construction (rounded)		\$	140,750
Design	8%	\$	12,000
Construction Administration	10%	\$	15,000
Total Design and Construction			167,750

1.6. Single-Lane Freeway-to-Freeway Ramp Meter

The geometric layout of this alternative is shown in Figure A-4. The basic layout assumes no widening is required. It is assumed the typical 16-foot-wide ramp lane is narrowed to 12 feet and that width is maintained for 100 feet. The transition tapers are 200 feet long for a 50-mph design speed.

Signal heads are mast-arm mounted and located outside the clear zone. Guardrail with approach end treatment on both sides of the ramp is included to protect the ramp meter cabinet, mast-arm pole, and two advance variable message sign (VMS) truss structures.

For the single-lane freeway-to-freeway ramp meter typical layout, the costs are estimated as shown in Table 5.

Table 5. Typical Single-Lane Freeway-to-Freeway Ramp Meter Construction Costs

Categories			otal Cost
Earthwork and Structures		\$	5,305
Guardrail		\$	31,500
Paving		\$	-
Drainage		\$	-
Signalization		\$	82,779
Communications		\$	7,400
Pavement Marking		\$	1,654
Signing		\$	112,300
Subtotal Construction (rounded)			240,940
Traffic Control	3%	\$	8,000
Contingencies	10%	\$	25,000
Construction (rounded)		\$	273,940
Design	8%	\$	22,000
Construction Administration	10%	\$	28,000
Total Design and Construction			323,940

1.7. Two-Lane Freeway-to-Freeway Ramp Meter

The geometric layout of this alternative is shown in Figure A-5. It is assumed the existing ramp has a 16-foot lane so widening would be necessary though it will be a site-specific issue. For this report, it is assumed an existing 16-foot ramp with 4-foot paved shoulders will be widened to two 12-foot lanes with 4-foot paved shoulders. The total pavement width will be 32 feet, which results in a net of 8 feet of total widening, or 4 feet on each side of the existing ramp. The transition tapers are 200 feet long for symmetrical widening and a 50-mph design speed.

Guardrail with approach end treatment on both sides of the ramp is included to protect the ramp meter cabinet, mast arm pole, and two advance VMS sign truss structures.

For the two-lane freeway-to-freeway ramp meter typical layout, the costs are estimated as shown in Table 6.

Table 6. Typical Two-Lane Freeway-to-Freeway Ramp Meter Construction Costs

Categories			otal Cost
Earthwork and Structures		\$	5,638
Guardrail		\$	31,500
Paving		\$	15,664
Drainage		\$	-
Signalization		\$	84,751
Communications		\$	7,400
Pavement Marking		\$	1,369
Signing		\$	113,600
Subtotal Construction (rounded)		\$	259,930
Traffic Control	3%	\$	8,000
Contingencies	10%	\$	26,000
Construction (rounded)		\$	293,930
Design	8%	\$	24,000
Construction Administration	10%	\$	30,000
Total Design and Construction			347,930

1.8. Optional Enforcement Features

Optional enforcement features consist of a paved enforcement area and a downstream-facing enforcement light. These features may be included together or individually.

The geometric design of a paved enforcement area located downstream of the ramp meter is shown in Figure E-1. The paved enforcement parking area is 12 feet wide x 75 feet long, plus transition tapers on each end. The paved surface is approximately 188 square yards. A sign has been included to identify the area.

The enforcement light, also shown in Figure E-1, is an additional 12-inch red signal face facing downstream of the ramp meter, wired to be on at the same time the red indication is on for vehicles, so that a law enforcement officer can monitor when the ramp meter is red. No appreciable additional wiring is needed.

No guardrail costs are included for the paved enforcement area.

Costs for the typical layout that includes both optional enforcement features are estimated in Table 7. The cost of an optional paved enforcement area only (without the enforcement light) would not include the Signalization category. The cost of an optional enforcement light without a paved enforcement area would be the Signalization category only.

Table 7. Typical Optional Enforcement Features Construction Costs

Categories		То	tal Cost
Earthwork and Structures		\$	1,003
Guardrail		\$	-
Paving		\$	6,016
Signalization		\$	528
Pavement Marking		\$	314
Signing		\$	650
Subtotal Construction (rounded)	Subtotal Construction (rounded)		8,510
Traffic Control	3%	\$	1,000
Contingencies	10%	\$	1,000
Construction (rounded)		\$	10,510
Design	8%	\$	1,000
Construction Administration	10%	\$	2,000
Total Design and Construction		\$	13,510

2. Program Costs

Program costs include the central software, servers, central communications hardware, integration, training, and firmware costs including installation and calibration.

2.1. Central Program Costs

Central program costs consist of the central software, servers, communications hardware, integration, and training. FDOT, Kansas DOT, GDOT, and a ramp metering vendor provided costs of their ramp metering software. Costs include the queue management algorithms to minimize the potential for ramp queues to back up on the cross streets. Cost estimates are as follows:

Description	Cost
Central Software	
Software and Installation	\$135,000
Driver and Installation	\$95,000
Integration	\$110,000
Training	\$20,000
Servers (2)	\$20,000
Misc. Central Communications Hardware	\$25,000
Total	\$405,000

Table 8. Program Costs

2.2. Firmware Costs

A vendor quote estimated the firmware the total cost for the controllers at \$50,000 for all 22 sites. Firmware installation and setup is estimated to take 1 day, and calibration is estimated to require 2 days per site.

Description	Cost	Assumptions
Firmware	\$2,273	
Installation	\$ 1,000.00	
Calibration	\$ 2,016.00	2 days per site
Total	\$ 5,300.00	

Table 9. Firmware Costs per Site

2.3. Maintenance

Poles, cabinets, and other equipment for ramp meters have essentially the same maintenance cost as is found in a typical traffic signal. Kansas DOT and GDOT provided an estimate of their annual maintenance costs. Data available through project reports and evaluation studies provided additional data points, although many of those costs are unusually low and not well defined concerning what is or is not included, even after adjusting

to present-day costs. Based on an average of Kansas and GDOT's costs, the estimated cost of annual scheduled (preventative) maintenance and unscheduled repairs is \$6,400 per site. This cost includes labor, equipment, and parts.

In addition, \$24,000 per year has been included for software support on the advice of FDOT, Kansas DOT, and a ramp metering vendor.

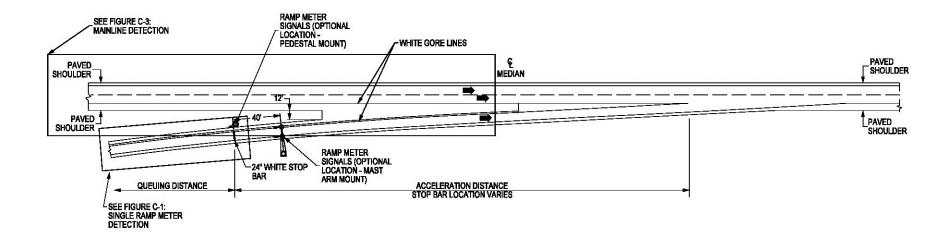
2.4. Operations

Operations costs consist of the cost to monitor the ramp meters from the STOC, respond to timing issues, and perform periodic adjustments in the operational parameters and management time. Based on information from Kansas DOT and GDOT, approximately 24 hours per site per year are spent monitoring and responding to timing type issues, which equates to:

2 engineers \times 50,000/each/167 = \$600 per site per year.

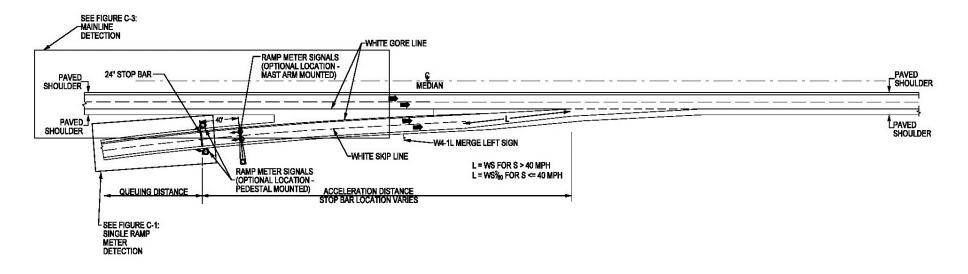
Appendices

Appendix A. Typical Ramp Meter Layouts



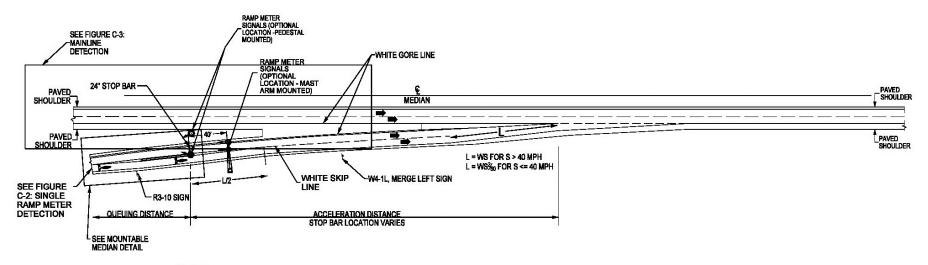
- When truck volumes exceed 5% on 3% or greater ascending grades, provide 500' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of payement are 10' apart.
- 2. See AASHTO Exhibit 3-1 for acceleration distances.
- Signal heads may be pedestal mounted or mast arm mounted as site conditions dictate.
- 4. See Figure B-1 for signalization and equipment.
- 5. See Figure C-1 for ramp meter detection.
- 6. See Figure C-3 for mainline detection.
- 7. See Figure D-1 for ramp meter signing and pavement markings.
- 8. See Figure D-2 for loop ramp signing and pavement markings.

Figure A-1: Single-Lane Ramp Meter Overview

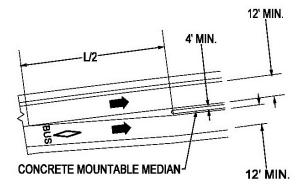


- When truck volumes exceed 5% on 3% or greater ascending grades, provide 500' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of pavement are 10' apart.
- 2. See AASHTO Exhibit 3-1 for acceleration distances.
- Signal heads may be pedestal mounted or mast arm mounted as site conditions dictate.
- Install W4-1L, merge left sign, in accordance with Table 2C-54 of the MUTCD.
- 5. See Figure B-1 for signalization and equipment.
- 6. See Figure C-1 for ramp meter detection.
- 7. See Figure C-3 for mainline detection.
- 8. See Figure D-1 for ramp meter signing and pavement markings.

Figure A-2: Two-Lane Ramp Meter Overview

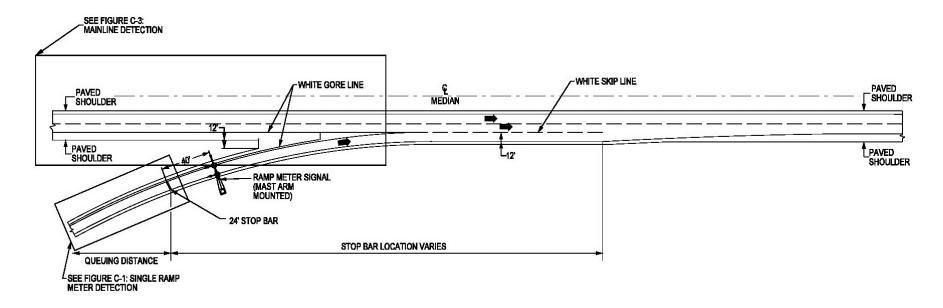


- When truck volumes exceed 5% on 3% or greater ascending grades, provide 500' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of pavement are 10' apart.
- 2. See AASHTO Exhibit 3-1 for acceleration distances.
- mountable median should extend upstream at least 100' and desirable to the forecasted queue length
- Minimum mountable median width is 4' with signal pedestal, minimum width is 2' without pedestal.
- Signal heads may be pedestal mounted or mast arm mounted as site conditions dictate.
- Install W4-1L, merge left sign, in accordance with Table 2C-54 of the MUTCD.
- 7. See Figure B-1 for signalization and equipment.
- 8. See Figure C-2 for ramp meter detection.
- 9. See Figure C-3 for mainline detection.
- 10. See Figure A-11 for ramp meter signing and pavement markings.



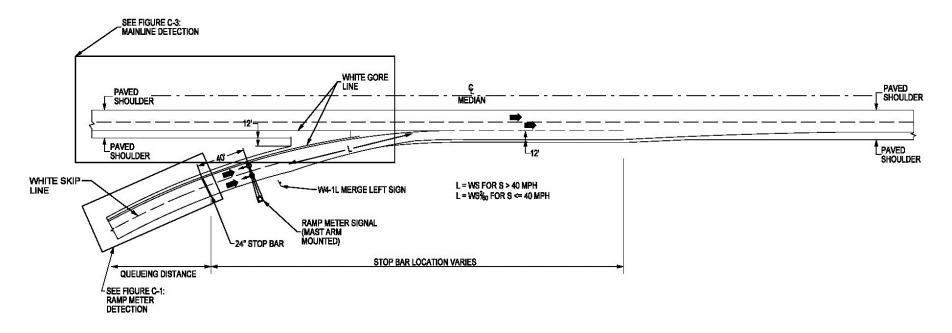
MOUNTABLE MEDIAN DETAIL

Figure A-3: Single-Lane Ramp Meter with Transit Bypass Overview



- When truck volumes exceed 5% on 3% or greater ascending grades, provide 500' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of pavement are 10' apart.
- 2. See AASHTO Exhibit 3-1 for acceleration distances.
- 3. Signal heads shall be mast arm mounted as site conditions dictate.
- 4. See Figure B-1 for signalization and equipment.
- 5. See Figure C-1 for ramp meter detection.
- 6. See Figure C-3 for mainline detection.
- 7. See Figures D-1 and D-3 for ramp meter signing and pavement markings.

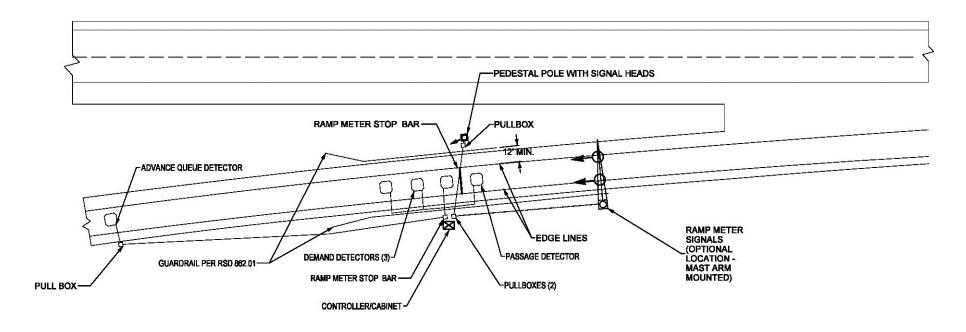
Figure A-4: Single-Lane Freeway to Freeway Ramp Meter Overview



- When truck volumes exceed 5% on 3% or greater ascending grades, provide 500' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of pavement are 10' apart.
- 2. See AASHTO Exhibit 3-1 for acceleration distances.
- 3. Signal heads shall be mast arm mounted as site conditions dictate.
- Install W4-1L, merge left sign, in accordance with Table 2C-54 of the MUTCD.
- 5. See Figure B-1 for signalization and equipment.
- 6. See Figure C-1 for ramp meter detection.
- 7. See Figure C-3 for mainline detection.
- 8. See Figures D-1 and D-3 for ramp meter signing and pavement markings.

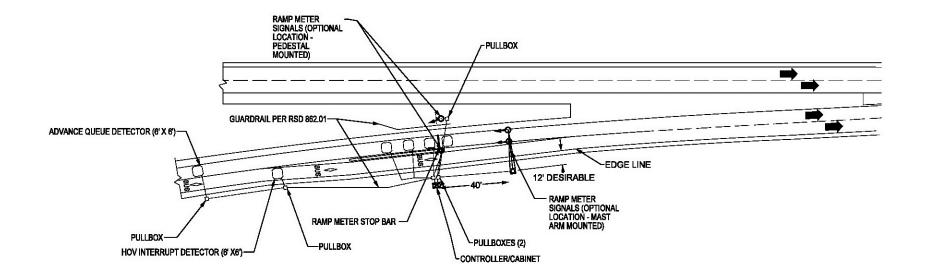
Figure A-5: Two-Lane Freeway to Freeway Ramp Meter Overview

Appendix B. Signal Head and Equipment Layouts



- Use pedestal mounted signals only for single lane non-freeway to freeway ramp locations. Locate pedestal mounted signals to the left of the ramp and pointed towards the stop bar to minimize view from the mainline.
- 2. Use mast arm mounted signals only for freeway to freeway ramp locations.
- 3. Mast arm supports and controller cabinet may be on either side of ramp as site conditions dictate.
- Protect signal pedestal and cabinet with guardrail or setback distance in accordance with clear zone standards.

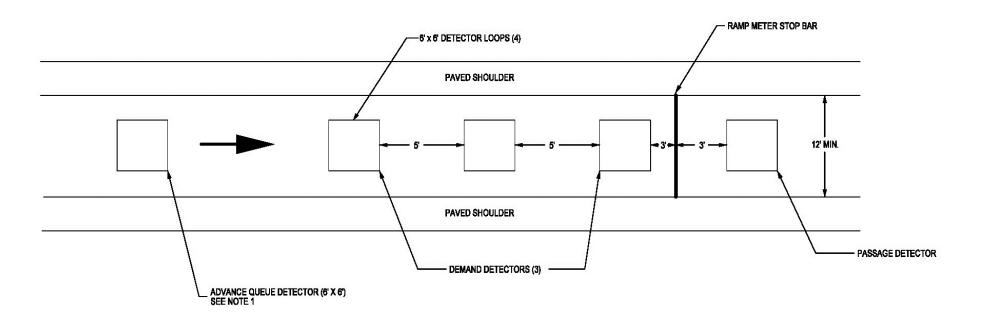
Figure B-1: Single-Lane Ramp Meter Signalization and Equipment Layout



- 1. Use pedestal mounted signals only for single lane non-freeway to freeway ramp locations.
- 2. Locate pedestal mounted signals to the left of the ramp and pointed towards the stop bar to minimize view from the mainline.
- 2. Protect signal pedestal and cabinet with guardrail or setback distance in accordance with clear zone standards.

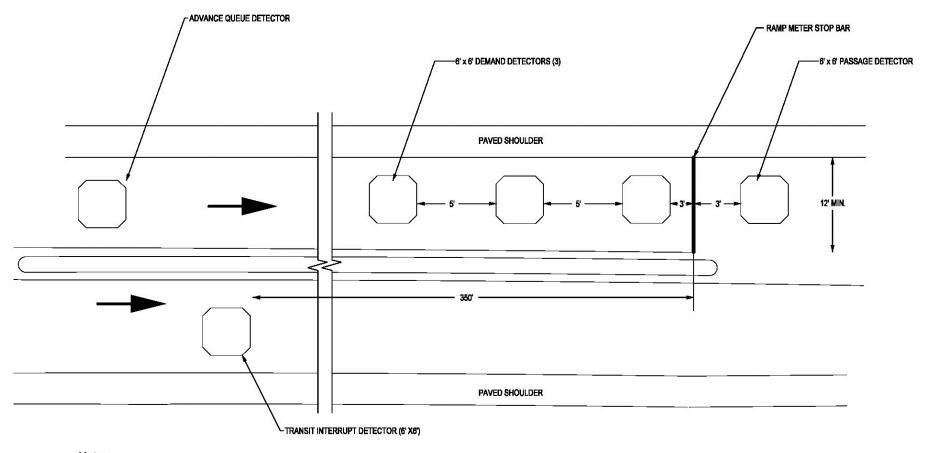
Figure B-2: Two-Lane Ramp Meter with Transit Bypass Signalization and Equipment Layout

Appendix C. Ramp and Mainline Detection Layouts



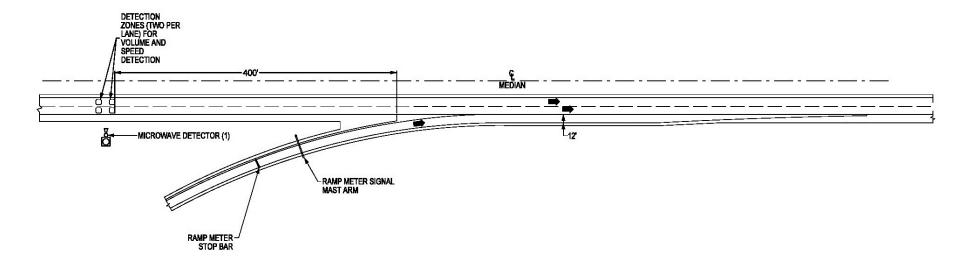
- Place advance queue detector upstream of predicted queue per Table 4 but no more than 300 feet from the surface street intersection.
- 2. For dual lane ramp meter place detectors in second lane at same longitudinal spacing.
- 3. See Figure C-3 for mainline detection.

Figure C-1: Single-Lane Ramp Meter Detection



- Place advance queue detector upstream of predicted queue per Table 4 but no more than 300 feet from the surface street intersection.
- 2. For dual lane ramp meter place detectors in second lane at same longitudinal spacing.
- 3. See Figure C-3 for mainline detection.

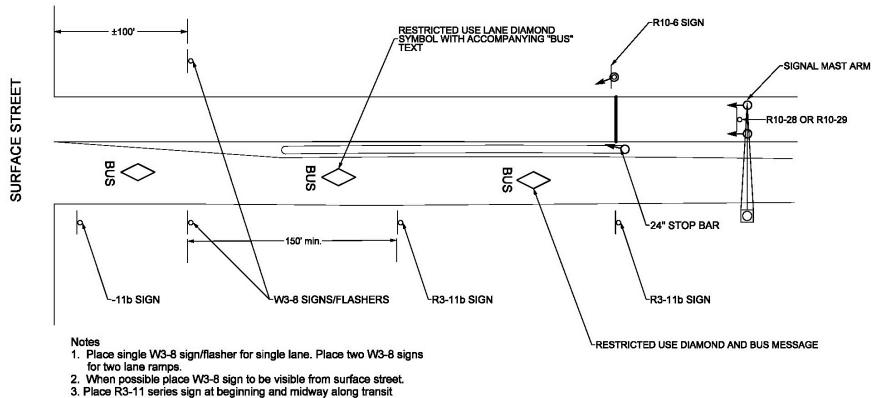
Figure C-2: Single-Lane Ramp Meter with Transit Bypass Detection



- 1. See Figures C-1 and C-2 ramp meter detection.
- Install microwave detector(s) according to manufacturer's recommendations to avoid signal distortion due to bridges, sign structures, walls and barriers.
- 3. Adjust detector location as required by site conditions.

Figure C-3: Mainline Detection

Appendix D. Typical Ramp Meter Signing Layouts



- Place R3-11 series sign at beginning and midway along transit restricted use lane.
- Place W4-1L downstream of ramp meter in accordance with Table 2C-54 of the MUTCD.

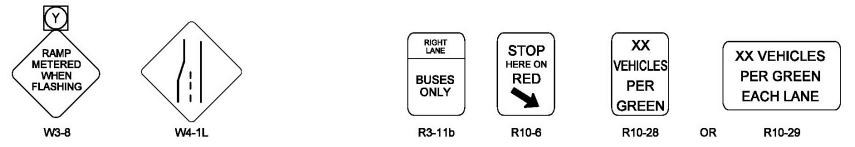
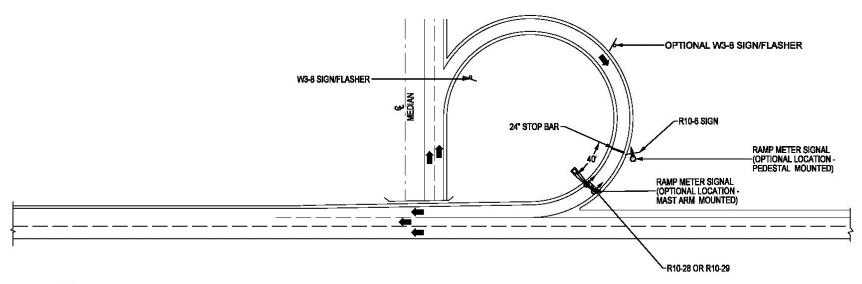


Figure D-1: Non-Freeway-to-Freeway Ramp Meter Signing and Pavement Markings



- When truck volumes exceed 5% on 3% or greater ascending grades, provide 1000' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of pavement are 10' apart.
- 2. Install additional W3-8 sign and flasher as necessary for locations where sight distance is limited.

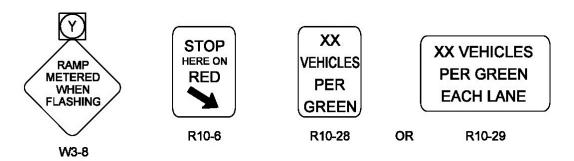


Figure D-2: Single-Lane Loop Ramp Meter Signing and Pavement Markings

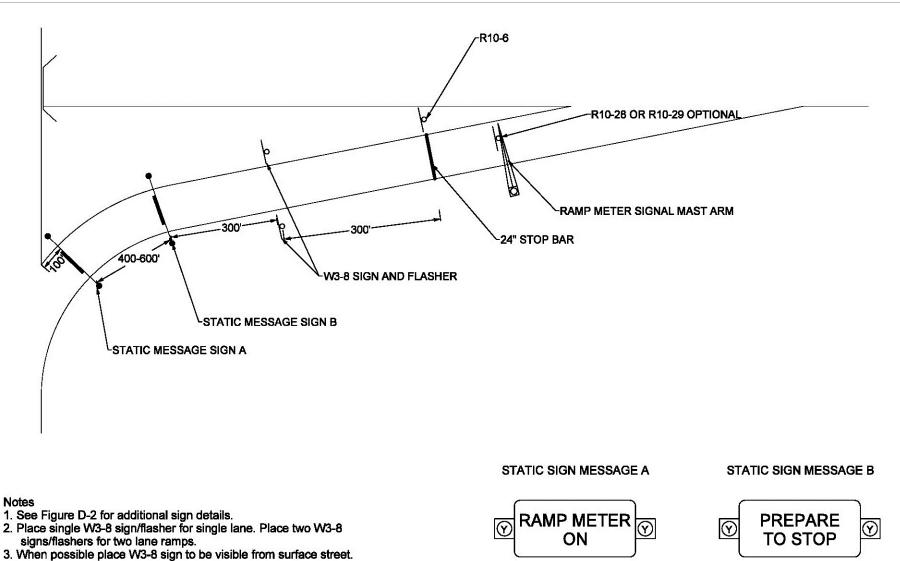
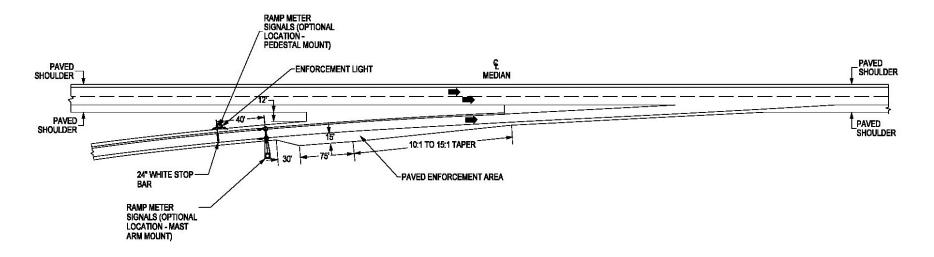


Figure D-3: Freeway-to-Freeway Ramp Meter Signing and Pavement Markings

Appendix E. Optional Enforcement Features



- 1. Begin taper to enforcement area 0-75' downstream of stop bar.
- 2. Dimensions may be adjusted to fit site conditions.
- 3. Enforcement areas are suitable locations having two metered lanes or one lane metered and one transit bypass lane.

Figure E-1: Optional Enforcement Features

Appendix F. Detailed Typical Cost Estimates

Table 10. Detailed Typical Single-Lane Ramp Meter Construction Costs

Categories Description	Unit	Quantity	Ha	nit Cost	_	otal Cost	Assumptions
Earthwork and Structures	JUIIIL	Quantity	UII	iii Cosi		otal Cost	Assumptions
Retaining Wall 5' High	LF	0	\$	250.00	\$	_	
Retaining Wall 10' High	LF	0	\$	475.00	\$	_	
Excavation	CY	0	\$	4.00	\$	-	
Fill	CY	0	\$	5.00	\$	_	
1 111	01	0	Ψ	3.00	Ψ		Seeding around trench, conduit runs,
Seeding	SY	1599	\$	2.50	\$	3,997.50	pull box, and foundation areas
Subtotal					\$	3,997.50	
Gustotai					¥	0,007.100	
Guardrail							
Guardrail Rail	LF	250	\$	15.00	\$	3,750.00	
Guardrail Approach End Treatment	EA	1		1.500.00	\$	1,500.00	
Subtotal			7	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	\$	5,250.00	
Subtotal				ļ	Ψ	0,200.00	
Drainage							
Pipe	LF	0	\$	44.00	\$	_	
Subtotal		Ŭ	Ψ	11.00	\$		
Subtotal					Ψ		
Cignolization							
Signalization	1						One queue, three passage and one
6'x6' loops	EA	5	\$	394.50	Φ	1,972.50	clearance
Detector Lead-in Cable	EA	390	\$	1.50	_		Assumed setback distance 350'
MVDS detector	EA	1		1,800.00			Mainline detection
Detector pole	EA	1		5,000.00	\$	6,000.00	IVIAITIIITIC GELECTIOTT
Pullbox (Std.)	EA	6	\$	300.00	\$	1,800.00	
Conduit (Trenched)	LF	2350	\$	6.00	_		All purposes
			_		Ť	,	
Conduit (Directional Drilled)	LF	50	\$	14.00	\$	700.00	One ramp crossing, multiple conduits
Electrical Service	EA	1	\$ 1	1,500.00	\$	1,500.00	
Electrical Conductors	LF	1000	\$	5.00	\$	5,000.00	
2070 Controller and Cabinet	EA	1	\$14	4,000.00	\$	14,000.00	
Firmware/Calibration	EA	1	\$ 5	5,300.00	\$	5,300.00	
Cabinet Foundation	EA	1	\$	450.00	\$	450.00	
45' Mast Arm Poles and Foundation	EA	0		5,000.00		-	
Pedestal Pole	EA	1		1,000.00		1,000.00	
Three Section Signal Head	EA	2	_	1,000.00	\$	2,000.00	
One Section Signal Head	EA	2	\$	500.00			Ramp meter advance signal
Signal Cable	LF	400	\$	2.75	\$	1,100.00	
Subtotal					\$	58,307.50	
							=
Communications							
Serial Communications	EA	350	\$	2.00	_	700.00	Link to MVDS
Splice Enclosure	EA	1		1,000.00	\$		Link to SMFO
Pullbox (Special Size)	EA	1	_	1,750.00	_	,	For splice enclosure
Interconnect Center	EA	1		1,500.00		1,500.00	In cabinet
Fiber-optic Drop Cable (six strands)	LF	500	\$	1.50	\$	750.00	Drop cable to controller cabinet
Ethernet Switch	EA	1	\$ 1	1,700.00	\$	1,700.00	
Subtotal					\$	7,400.00	

D						
Pavement Marking						
						40 mph design speed. 110'
Pavement Marking Removal	LF	640	\$ 0.62	\$	396.80	transitions, 100' narrowed lane
Raised Pavement Markers	EA	0	\$ 4.50	\$	-	
White Edge Line	LF	320	\$ 0.95	\$	304.00	110' transitions, 100' narrowed lane
Yellow Edge Line	LF	320	\$ 0.95	\$	304.00	110' transitions, 100' narrowed lane
24" Stop Bar	LF	12	\$ 7.00	\$	84.00	
Subtotal				\$	1,088.80	
						Ц
Signing						
W3-8, Ramp Metered When Flashing	EΑ	2	\$ 650.00	\$	1,300.00	Sign and post only
W3-4, Be Prepared to Stop	EΑ	1	\$ 650.00	\$	650.00	Sign and post
R10-6, Stop Here on Red	EΑ	1	\$ 175.00	\$	175.00	Pedestal mounted
R10-28, XX Vehicles Per Green	EA	1	\$ 175.00	\$	175.00	Pedestal mounted
Subtotal				\$	2,300.00	
Subtotal Construction (Rounded)				\$	78,350.00	
Traffic Control			3%	\$	3,000.00	
Contingencies			10%	\$	8,000.00	
Total Construction (Rounded)				\$	89,350.00	
	•				•	- •
Design			8%	\$	8,000.00	
Construction Administration			10%	\$	9,000.00	
Total Design and Construction				\$1	06,350.00	

 Table 11.
 Detailed Typical Single-Lane Loop Ramp Meter Construction Costs

Categories	Description	Unit	Quantity	U	nit Cost	T	otal Cost	Assumptions
Earthwork and St	tructures_							
Retaining Wall	5' High	LF	0	\$	250.00	\$	-	
Retaining Wall	10' High	LF	0	\$	475.00	\$	-	
Excavation	-	CY	0	\$	4.00	\$	_	
Fill		CY	0	\$	5.00	\$	-	
								Seeding around trench, conduit runs
Seeding		SY	1599	\$	2.50	\$	3,997.50	pull box, and foundation areas
Subtotal		<u> </u>	•			\$	3,997.50	
					ļ	<u> </u>		4
Guardrail								
Guardrail Rail		LF	250	\$	15.00	\$	3,750.00	
	roach End Treatment	EA	1	\$	1,500.00	\$	1,500.00	
Subtotal			l	,	,	\$	5,250.00	
Oublotai							0,200.00	<u>.l</u>
Drainage								
Pipe		LF	0	\$	44.00	2.		
		-	· ·	Ψ	77.00	_		
Subtotal						\$		
.								
<u>Signalization</u>		1		_		_		To .
01.011			_	_	004.50	_	4 070 50	One queue, three passage and one
6'x6' loops		EA	5	\$	394.50	_	1,972.50	clearance
Detector Lead		EA	390	\$	1.50		585.00	Assumed setback distance 350'
MVDS detector	or	EA	1		1,800.00			Mainline detection
Detector pole		EA	1	_	6,000.00		6,000.00	
Pullbox (Std.)	.L - IV	EA	6	\$	300.00	_	1,800.00	Aller
Conduit (Trend		LF	2350	\$	6.00		14,100.00	
Conduit (Direc		LF	50	\$	14.00		700.00	One ramp crossing, mult. conduits
Electrical Serv		EA	1		1,500.00		1,500.00	
Electrical Con		LF	1000	\$	5.00		5,000.00	
2070 Controlle		EA	1		4,000.00		14,000.00	
Firmware/Cali		EA	1		5,300.00		5,300.00	
Cabinet Found		EA	1	\$			450.00	
	Poles and Foundation	EA EA	0		5,000.00		1 000 00	
Pedestal Pole			1	_	1,000.00	_	1,000.00	
Three Section	Signal Head	EA	2		1,000.00		2,000.00	Barranatara
One Section S	ignal Head	EA	2	\$	500.00		1,000.00	Ramp meter advance signal
Signal Cable		LF	400	\$	2.75	_	1,100.00	
Subtotal						\$	58,307.50	
Communications								
Serial Commu	nications	EA	350	\$	2.00	\$	700.00	Link to MVDS
Splice Enclosu	ure	EA	1	\$	1,000.00	\$	1,000.00	Link to SMFO
Pullbox (Speci	al Size)	EA	1	\$	1,750.00	\$	1,750.00	For splice enclosure
Interconnect C	enter	EA	1	\$	1,500.00	\$	1,500.00	In cabinet
	op Cable (six strands)	LF	500	\$	1.50		750.00	Drop cable to controller cabinet
Ethernet Switch		EA	1	\$	1,700.00		1,700.00	
Subtotal						\$	7,400.00	

Pavement Marking						
T GVOTTOTIC MAINING						30 mph design speed, 60'
Pavement Marking Removal	LF	440	l s	0.62	\$ 272.80	transitions, 100' narrowed lane
Raised Pavement Markers	EA	0	\$	4.50	-	, , , , , , , , , , , , , , , , , , , ,
White Edge Line	LF	220	\$	0.95	\$ 209.00	60' transitions, 100' narrowed lane
Yellow Edge Line	LF	220	\$	0.95	\$ 209.00	60' transitions, 100' narrowed lane
24" Stop Bar	LF	12	\$	7.00	\$ 84.00	
Subtotal					\$ 774.80	
				1		4
Signing						
W3-8, Ramp Metered When Flashing	EA	2	\$	650.00	\$ 1,300.00	Sign and post only
W3-4, Be Prepared to Stop	EA	1	\$	650.00	\$ 650.00	Sign and post
R10-6, Stop Here on Red	EA	1	\$	175.00	\$ 175.00	Pedestal mounted
R10-28, XX Vehicles Per Green	EA	1	\$	175.00	\$ 175.00	Pedestal mounted
Subtotal					\$ 2,300.00	
Subtotal Construction (Rounded)					\$ 78,030.00	
Traffic Control				3%	\$ 3,000.00	Ĭ
Contingencies				10%	\$ 8,000.00	
Total Construction (Rounded)					\$ 89,030.00	
						•
Design				8%	\$ 8,000.00	
Construction Administration				10%	\$ 9,000.00	
Total Design and Construction					\$ 106,030.00	

 Table 12.
 Detailed Typical Two-Lane Ramp Meter Construction Costs

Outron and a December than	112	0		- '4 🔿 4	-	-1-101	A
Categories Description	Unit	Quantity	Ur	nit Cost	l	otal Cost	Assumptions
Earthwork and Structures	1		I	050.00	٠,		I
Retaining Wall 5' High	LF	0	\$	250.00		-	
Retaining Wall 10' High	LF	0	\$	475.00		-	
Excavation	CY	0	\$	4.00	_	-	
Fill	CY	0	\$	5.00	\$	-	
							Seeding along pavement widening
			١.		١.		and around trench, conduit, pull box,
Seeding	SY	1626	\$	2.50	\$,	and foundation areas
Subtotal					\$	4,065.00	
					•		u
Guardrail							
Guardrail Rail	LF	500	\$	15.00	\$	7,500.00	
Guardrail Approach End Treatment	EA	2	\$	1,500.00	\$	3,000.00	
Subtotal						10,500.00	
Gustotai					Ψ	10,500.00	Ш
Doving							
Paving	I CV	250	٠	20.00	·	11 202 22	Г
Ramp Widening	SY	356	\$	32.00 12.00		11,392.00 4,272.00	
Pavement Resurfacing	SY	356	Ъ	12.00			
Subtotal					\$	15,664.00	
Drainage							
Pipe	LF	0	\$	44.00	\$	-	
Subtotal					\$	-	
							4
Signalization							
<u>Orginalization</u>							One queue, three passage and one
6'x6' loops	EA	10	\$	394.50	\$	3,945.00	clearance
Detector Lead-in Cable	EA	390	\$	1.50		-,	Assumed setback distance 350'
MVDS detector	EA	1	_	1,800.00			Mainline detection
Detector pole	EA	1	_	6,000.00	_	6,000.00	
Pullbox (Std.)	EA	6	\$	300.00		1,800.00	
Conduit (Trenched)	LF	2385	\$	6.00	_		All purposes
Conduit (Trenched) Conduit (Directional Drilled)	LF	50	\$	14.00	_	700.00	One ramp crossing, mult. conduits
· ,							One ramp crossing, muit. conduits
Electrical Service	EA	1	_	1,500.00	_	1,500.00	
Electrical Conductors	LF	1000	\$	5.00		5,000.00	
2070 Controller and Cabinet	EA	1		4,000.00			
Firmware/Calibration	EA	1	_	5,300.00		5,300.00	
Cabinet Foundation	EA	1	\$	450.00		450.00	
45' Mast Arm Poles and Foundation	EA	0	-	5,000.00	_	-	
Pedestal Pole	EA	2		1,000.00			dual pedestals
Three Section Signal Head	EA	2	_	1,000.00	_	2,000.00	
One Section Signal Head	EA	2	\$	500.00	\$	1,000.00	Ramp meter advance signal
Signal Cable	LF	505	\$	2.75	\$	1,388.75	
Subtotal					\$	61,778.75	
					<u> </u>		Ш
Communications							
Communications	1				Г		
Serial Communications	EA	350	¢.	2 00	φ.	700.00	Link to MV/DS
	EA	1	\$	2.00 1,000.00	\$		Link to MVDS Link to SMFO
Splice Enclosure					_		
Pullbox (Special Size)	EA	1		1,750.00			For splice enclosure
Interconnect Center	EA	1 500		1,500.00			In cabinet
	1 1 5	500	\$	1.50	\$	750.00	Drop cable to controller cabinet
Fiber-optic Drop Cable (six strands)	LF						Drop cable to controller cabillet
Ethernet Switch Subtotal	EA	1		1,700.00		1,700.00 7,400.00	Drop capie to controller capillot

Payament Marking							
Pavement Marking			1				40 mph design speed. 110'
Pavement Marking Removal	LF	640	\$	0.62	Ф	396.80	transitions, 100' narrowed lane
Raised Pavement Markers	EA	3	\$	4.50		13.50	Along skip line only
White Edge Line	LF	320	\$	0.95	-	304.00	110' transitions, 100' narrowed lane
y .	LF	320	\$	0.95		304.00	110' transitions, 100' narrowed lane
Yellow Edge Line	LF	200	\$		_	47.50	The transitions, 100 harrowed lane
White Skip Line	LF	12	\$	7.00	-	84.00	
24" Stop Bar	LF	12	Φ	7.00	Ť		
Subtotal					\$	1,149.80	
Signing							
W3-8, Ramp Metered When Flashing	EA	2	\$	650.00	\$		Sign and post only
W3-4, Be Prepared to Stop	EA	1	\$	650.00	\$	650.00	Sign and post
R10-6, Stop Here on Red	EA	1	\$	175.00	\$	175.00	Pedestal mounted
R10-28, XX Vehicles Per Green	EA	1	\$	175.00	\$	175.00	Pedestal mounted
W4-1L, Merge Left	EA	1	\$	650.00	69	650.00	
Subtotal					\$	2,950.00	
Subtotal Construction (Rounded)					\$1	03,510.00	
Traffic Control				3%	\$	4,000.00	
Contingencies				10%	\$	11,000.00	
Total Construction (Rounded)					\$1	18,510.00	
Design				8%	\$	10,000.00	
Construction Administration				10%	\$	12,000.00	
Total Design and Construction					\$1	40,510.00	

Table 13. Detailed Typical Single-Lane Ramp Meter with Transit Bypass Ramp Construction Costs

Earthwork and Structures Retaining Wall 5' High Retaining Wall 10' High Excavation Fill		Quantity	U	nit Cost	Т	otal Cost	Assumptions
Retaining Wall 10' High Excavation							
Retaining Wall 10' High Excavation	LF	0	\$	250.00	\$	-	
	LF	0	\$	475.00	\$	-	
	CY	0	\$	4.00		-	
	CY	0	\$	5.00	\$	-	
			+		_		
Seeding Subtotal	SY	1760	\$	2.50	\$	4,400.00 4,400.00	Seeding along pavement widening and around trench, conduit, pull box, and foundation areas
- Canada				I	Ť	1,100.00	
Guardrail							
Guardrail Rail	LF	500	\$	15.00	\$	7,500.00	
Guardrail Approach End Treatment	EA	2	\$	1,500.00	\$	3,000.00	
Subtotal					\$	10,500.00	
				l	÷		
Paving							
Traffic Separator, 4' Wide	LF	200	\$	32.00	\$	6,400.00	
Ramp Widening	SY	623	\$	32.00	\$	19,936.00	
Pavement Resurfacing	SY	623	\$	12.00	\$	7,476.00	
<u> </u>	31	023	Ψ	12.00			
Subtotal					\$	33,812.00	
<u>Drainage</u>					_		
Pipe	LF	0	\$	44.00	\$	-	
Subtotal					\$	-	
							•
Signalization							
							One queue, three passage and one
6'x6' loops	EA	6	\$	394.50	\$	2,367.00	clearance
Detector Lead-in Cable	EΑ	400	\$	1.50	\$	600.00	Assumed setback distance 350'
MVDS detector	EΑ	1	\$	1,800.00	\$	1,800.00	Mainline detection
Detector pole	EΑ	1	\$	6,000.00	\$	6,000.00	
Pullbox (Std.)	EΑ	6	\$	300.00	\$	1,800.00	
Conduit (Trenched)	LF	2385	\$	6.00	\$		All purposes
Conduit (Directional Drilled)	LF	50					
	EA		1 3	14.00 1	ъ.	700.00	One ramp crossing, mult, conduits
,		1	\$	14.00	\$	1 500 00	One ramp crossing, mult. conduits
Electrical Service		1000	\$	1,500.00	\$	1,500.00	One ramp crossing, mult. conduits
Electrical Service Electrical Conductors	LF	1000	\$	1,500.00 5.00	\$	1,500.00 5,000.00	One ramp crossing, mult. conduits
Electrical Service Electrical Conductors 2070 Controller and Cabinet	LF EA	1000	\$ \$ \$1	1,500.00 5.00 4,000.00	\$ \$	1,500.00 5,000.00 14,000.00	One ramp crossing, mult. conduits
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration	LF EA EA	1000 1 1	\$ \$ \$1 \$	1,500.00 5.00 4,000.00 5,300.00	\$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00	One ramp crossing, mult. conduits
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation	LF EA EA	1000 1 1 1	\$ \$ \$1 \$	1,500.00 5.00 4,000.00 5,300.00 450.00	\$ \$ \$ \$	1,500.00 5,000.00 14,000.00	One ramp crossing, mult. conduits
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation	LF EA EA EA	1000 1 1 1 1 0	\$ \$1 \$ \$ \$1	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00	\$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00	
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole	LF EA EA EA EA	1000 1 1 1 0 2	\$ \$1 \$ \$ \$1	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00	\$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00	One ramp crossing, mult. conduits one on island one on left side
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head	LF EA EA EA EA EA	1000 1 1 1 1 0 2	\$ \$ \$1 \$ \$ \$1 \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00	\$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00	one on island one on left side
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head	LF EA EA EA EA EA	1000 1 1 1 0 2 2	\$ \$ \$1 \$ \$ \$1 \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 500.00	\$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00 1,000.00	
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head	LF EA EA EA EA EA	1000 1 1 1 1 0 2	\$ \$ \$1 \$ \$ \$1 \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00	\$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00 1,000.00 1,388.75	one on island one on left side
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head	LF EA EA EA EA EA	1000 1 1 1 0 2 2	\$ \$ \$1 \$ \$ \$1 \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 500.00	\$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00 1,000.00	one on island one on left side
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable	LF EA EA EA EA EA	1000 1 1 1 0 2 2	\$ \$ \$1 \$ \$ \$1 \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 500.00	\$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00 1,000.00 1,388.75	one on island one on left side
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal	LF EA EA EA EA EA	1000 1 1 1 0 2 2	\$ \$ \$1 \$ \$ \$1 \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 500.00	\$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00 1,000.00 1,388.75	one on island one on left side
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable	LF EA EA EA EA EA	1000 1 1 1 0 2 2	\$ \$ \$1 \$ \$ \$1 \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 500.00	\$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00 1,000.00 1,388.75	one on island one on left side
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications	LF EA EA EA EA EA EA LF	1000 1 1 1 0 2 2 2 505	\$ \$1 \$ \$1 \$ \$ \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 500.00 2.75	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00 1,000.00 1,388.75 60,215.75	one on island one on left side Ramp meter advance signal
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications	LF EA EA EA EA EA LF	1000 1 1 1 0 2 2 2 505	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 2.75	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00 1,000.00 1,388.75 60,215.75	one on island one on left side Ramp meter advance signal Link to MVDS
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure	LF EA EA EA EA EA EA EA LF	1000 1 1 1 0 2 2 505	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 2.75 2.00 1,000.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 2,000.00 1,000.00 1,388.75 60,215.75	one on island one on left side Ramp meter advance signal Link to MVDS Link to SMFO
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure Pullbox (Special Size)	LF EA EA EA EA EA EA LF	1000 1 1 1 0 2 2 2 505	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 2.75 2.00 1,000.00 1,000.00 1,000.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 1,000.00 1,388.75 60,215.75 700.00 1,000.00 1,750.00	one on island one on left side Ramp meter advance signal Link to MVDS Link to SMFO For splice enclosure
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure Pullbox (Special Size) Interconnect Center	LF EA EA EA EA EA LF	1000 1 1 1 0 2 2 2 505	\$ \$ \$1 \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 2.75 2.00 1,000.00 1,750.00 1,500.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 1,000.00 1,388.75 60,215.75 700.00 1,000.00 1,750.00 1,500.00	one on island one on left side Ramp meter advance signal Link to MVDS Link to SMFO For splice enclosure In cabinet
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure Pullbox (Special Size) Interconnect Center Fiber-optic Drop Cable (six strands)	LF EA EA EA EA EA LF	1000 1 1 1 0 2 2 2 505	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 2.75 2.00 1,000.00 1,750.00 1,500.00 1,500.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 1,000.00 1,388.75 60,215.75 700.00 1,000.00 1,750.00 1,500.00 750.00	one on island one on left side Ramp meter advance signal Link to MVDS Link to SMFO For splice enclosure
Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure Pullbox (Special Size) Interconnect Center	LF EA EA EA EA EA LF	1000 1 1 1 0 2 2 2 505	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 2.75 2.00 1,000.00 1,750.00 1,500.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1,500.00 5,000.00 14,000.00 5,300.00 450.00 - 2,000.00 1,000.00 1,388.75 60,215.75 700.00 1,000.00 1,750.00 1,500.00	one on island one on left side Ramp meter advance signal Link to MVDS Link to SMFO For splice enclosure In cabinet

Pavement Marking							
1 avernerit Marking	1	l	1				To narrow lanes, 40 MPH, maintain
							one edge line, pave over other
Pavement Marking Removal	LF	0	\$	0.62	\$	_	edge line
- avoinom manarig recine tai	 - -		+ +	0.02	Ť		Along skip line only and both sides
Raised Pavement Markers	l _{EA}	6	\$	4.50	\$	27.00	of median
		_	Ť		Ť		To narrow lanes, 40 MPH, 190'
White Edge Line	LF	980	\$	0.95	\$	931.00	transition
							To narrow lanes, 40 MPH, 190'
Yellow Edge Line	LF	580	\$	0.95		551.00	transition
24" Stop Bar	LF	24	\$	7.00	\$	168.00	
White Skip Line	LF	0	\$	0.24		-	
Bus Message	EA	3	\$	510.00	\$	1,530.00	
Diamond Symbol	EA	3	\$	120.00	\$	360.00	
Subtotal					\$	3,567.00	
							•
Signing							
W3-8, Ramp Metered When Flashing	EA	2	\$	650.00	\$		Sign and post only
W3-4, Be Prepared to Stop	EA	1	\$	650.00	\$	650.00	Sign and post
R3-11b, Buses Only	EA	3	\$	300.00	\$	900.00	
R10-6, Stop Here on Red	EA	1	\$	175.00	\$		Pedestal mounted
R10-28, XX Vehicles Per Green	EA	1	\$	175.00	\$		Pedestal mounted
W4-1L, Merge Left	EA	1	\$	650.00	\$	650.00	
Subtotal					\$	3,850.00	
Subtotal Construction (Rounded)						123,750.00	
Traffic Control				3%	\$	4,000.00	
Contingencies				10%	\$	13,000.00	
Total Construction (Rounded)					\$ 1	140,750.00	
-							-
Design				8%	\$	12,000.00	
Construction Administration				10%	\$	15,000.00	
Total Design and Construction					\$ 1	167,750.00	
-			_				

Table 14. Detailed Typical Single-Lane Freeway-to-Freeway Ramp Meter Construction Costs

Onto mente al Decembrita in	11114	0	11-11-11		T-1-1 O1	A
Categories Description	Unit	Quantity	Unit Cost		Total Cost	Assumptions
Earthwork and Structures	Lie	_	ф <u>ого оо</u>	Iπ		T
Retaining Wall 5' High	LF LF	0	\$ 250.00 \$ 475.00		-	
Retaining Wall 10' High		-			-	
Excavation	CY	0	\$ 4.00		-	
Fill	CY	0	\$ 5.00	\$	-	
	0)/	0400		_	500500	Seeding around trench, pull box,
Seeding	SY	2122	\$ 2.50	_	5,305.00	conduit, and foundation areas
Subtotal				\$	5,305.00	
Guardrail	_					
Guardrail Rail	LF	1500	\$ 15.00	\$	22,500.00	
Guardrail Approach End Treatment	EA	6	\$ 1,500.00	\$	9,000.00	
Subtotal				\$	31,500.00	
			· ·	_	· · · · · · · · · · · · · · · · · · ·	
Drainage						
Pipe	LF	0	\$ 44.00	\$	_	
Subtotal			Ψσσ	\$		
Subtotal				Ψ		Ш
0. 1. 1.						
Signalization	1			_		lo
	l	_		_	4 070 70	One queue, three passage and one
6'x6' loops	EA	5	\$ 394.50		1,972.50	clearance
Detector Lead-in Cable	EA	390	\$ 1.50			Assumed setback distance 350'
MVDS detector	EA	1	\$ 1,800.00			Mainline detection
Detector pole	EA	1	\$ 6,000.00		6,000.00	
Pullbox (Std.)	EA	10	\$ 300.00		3,000.00	
Conduit (Trenched)	LF	3110	\$ 6.00			All purposes
Conduit (Directional Drilled)	LF	50	\$ 14.00		700.00	One ramp crossing, mult. conduits
Electrical Service	EA	1	\$ 1,500.00		1,500.00	
Electrical Conductors	LF	1000	\$ 5.00		5,000.00	
2070 Controller and Cabinet	EA	1	\$14,000.00		14,000.00	
Firmware/Calibration	EA	1	\$ 5,300.00	\$	5,300.00	
Cabinet Foundation	EA	1	\$ 450.00	\$	450.00	
45' Mast Arm Poles and Foundation	EA	1	\$15,000.00		15,000.00	
Pedestal Pole	EA	0	\$ 1,000.00	\$	-	
Three Section Signal Head	EA	2	\$ 1,000.00		2,000.00	
One Section Signal Head	EA	6	\$ 500.00	\$	3,000.00	Ramp meter advance signal
Signal Cable	LF	1386	\$ 2.75	\$	3,811.50	
Subtotal	•	•		\$	82,779.00	
					,	<u> </u>
Communications						
Serial Communications	EA	350	\$ 2.00	¢	700 00	Link to MVDS
Splice Enclosure	EA	1	\$ 1,000.00			Link to MVD3
Pullbox (Special Size)	EA	1	\$ 1,000.00			For splice enclosure
Interconnect Center	EA	1	\$ 1,750.00			In cabinet
Fiber-optic Drop Cable (six strands)	LF	500	\$ 1.50 \$ 1,700.00			Drop cable to controller cabinet
Ethernet Switch	EA	1	φ 1,700.00	_	1,700.00	<u> </u>
Subtotal				\$	7,400.00	
Pavement Marking						
						50 MPH design speed, 200'
Pavement Marking Removal	LF	1000	\$ 0.62	\$	620.00	transitions, 100' narrowed lane
Raised Pavement Markers	EA	0	\$ 4.50		_	
						200' transitions, 100' narrowed lane,
White Edge Line	LF	500	\$ 0.95	\$	475.00	
				Ė		200' transitions, 100' narrowed lane,
Yellow Edge Line	LF	500	\$ 0.95	\$	475.00	
24" Stop Bar	LF	12	\$ 7.00		84.00	
Subtotal		1		\$	1,654.00	Ŭ '
- Cuntotal				Ψ	1,007.00	1

ΙΕΛ	2	¢ 650.00	Φ	1 300 00	Sign and post only
	4	+	1		9 , ,
	1	Ψ	-		Sign and post
ĿΑ	1	\$ 175.00	\$	175.00	Pedestal mounted
EA	1	\$ 175.00	\$	175.00	Pedestal mounted
EA	2	\$50,000.00	\$	100,000.00	
EA	1	\$ 5,000.00	\$	5,000.00	
EA	1	\$ 5,000.00	\$	5,000.00	
			\$	112,300.00	
			\$	240,940.00	
		3%	\$	8,000.00	
		10%	\$	25,000.00	
			\$	273,940.00	
					•
				_	
		8%	\$	22,000.00	
•		10%	\$	28,000.00	
			\$	323,940.00	
	EA EA	EA 1 EA 1 EA 1 EA 2 EA 1	EA 1 \$ 650.00 EA 1 \$ 175.00 EA 1 \$ 175.00 EA 2 \$50,000.00 EA 1 \$ 5,000.00 EA 1 \$ 5,000.00 EA 1 \$ 10%	EA 1 \$ 650.00 \$ EA 1 \$ 175.00 \$ EA 1 \$ 175.00 \$ EA 1 \$ 175.00 \$ EA 2 \$50,000.00 \$ EA 1 \$ 5,000.00 \$ EA 1 \$ 5,000.00 \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	EA 1 \$ 650.00 \$ 650.00 EA 1 \$ 175.00 \$ 175.00 EA 1 \$ 175.00 \$ 175.00 EA 2 \$50,000.00 \$ 100,000.00 EA 1 \$ 5,000.00 \$ 5,000.00 EA 1 \$ 5,000.00 \$ 240,940.00

Table 15. Detailed Typical Two-Lane Freeway-to-Freeway Ramp Meter Construction Costs

Categories Description	Unit	Quantity	Un	it Cost	1	Total Cost	Assumptions
Earthwork and Structures	1	,					
Retaining Wall 5' High	LF	0	\$	250.00		-	
Retaining Wall 10' High	LF	0	\$	475.00	\$	-	
Excavation	CY	0	\$	4.00	\$	-	
Fill	CY	0	\$	5.00	\$	-	
							Seeding along pavement widening
							and around trench, conduit, pull box,
Seeding	SY	2255	\$	2.50	\$	5,637.50	and foundation areas
Subtotal	•	•			\$	5,637.50	
				l		,	
Guardrail							
Guardrail Rail	LF	1500	\$	15.00	\$	22,500.00	
Guardrail Approach End Treatment	EA	6	\$ 1	,500.00	\$	9,000.00	
• •	1 = / \		Ψ.	1,000.00	Ë		
Subtotal					\$	31,500.00	
Paving							
Traffic Separator, 4' Wide	LF	0	\$	32.00	_	-	
Ramp Widening	SY	356	\$	32.00	\$	11,392.00	
Pavement Resurfacing	SY	356	\$	12.00	\$	4,272.00	
Subtotal					\$	15,664.00	
				!			•
Drainage							
Pipe	LF	0	\$	44.00	\$	-	
Subtotal					\$	-	
Gubiotai					Ψ		
Cianalia di a							
Signalization	1		1				
0.01	_,	4.0	_	00450	 	0.045.00	One queue, three passage and one
6'x6' loops	EA	10	\$	394.50			clearance
Detector Lead-in Cable	EA	390	\$	1.50			Assumed setback distance 350'
MVDS detector	EA	1	151	00.008,	\$		Mainline detection
L)etector nole					_		
Detector pole	EA	1	\$ 6	5,000.00		6,000.00	
Pullbox (Std.)	EA	10	\$ 6 \$	300.00	\$	3,000.00	
Pullbox (Std.) Conduit (Trenched)	EA LF	10 3110	\$ 6 \$	300.00 6.00	\$ \$	3,000.00 18,660.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled)	EA LF LF	10 3110 50	\$ 6 \$ \$	300.00 6.00 14.00	\$ \$	3,000.00 18,660.00 700.00	
Pullbox (Std.) Conduit (Trenched)	EA LF LF EA	10 3110	\$ 6 \$ \$ \$ \$	300.00 6.00	\$ \$ \$	3,000.00 18,660.00 700.00 1,500.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled)	EA LF LF EA LF	10 3110 50	\$ 6 \$ \$ \$ \$ 1	300.00 6.00 14.00 1,500.00 5.00	\$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service	EA LF LF EA	10 3110 50 1	\$ 6 \$ \$ \$ \$ 1	300.00 6.00 14.00 1,500.00	\$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors	EA LF LF EA LF	10 3110 50 1 1000	\$ 6 \$ \$ \$ 1 \$	300.00 6.00 14.00 1,500.00 5.00	\$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet	EA LF LF EA LF	10 3110 50 1 1000	\$ 6 \$ \$ \$ 1 \$	300.00 6.00 14.00 1,500.00 5.00 4,000.00	\$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation	EA LF LF EA LF EA	10 3110 50 1 1000 1	\$ 6 \$ \$ \$ 1 \$ \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 6,300.00 450.00	\$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 5,300.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration	EA LF LF EA LF EA EA	10 3110 50 1 1000 1 1	\$ 6 \$ \$ \$ 1 \$ 5 \$ \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 5,300.00	\$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 5,300.00 450.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation	EA LF LF EA LF EA EA EA	10 3110 50 1 1000 1 1 1	\$ 6 \$ \$ \$ 1 \$ 1 \$ 5 \$ 5 \$ 1	300.00 6.00 14.00 1,500.00 5.00 4,000.00 450.00 5,000.00	\$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 5,300.00 450.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head	EA LF LF EA LF EA EA EA EA	10 3110 50 1 1000 1 1 1 1	\$ 6 \$ \$ \$ 1 \$ 5 \$ 5 \$ 1 \$ 5 \$ 1	300.00 6.00 14.00 1,500.00 5.00 4,000.00 450.00 4,000.00 1,000.00	\$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 5,300.00 450.00 15,000.00	All purposes One ramp crossing, mult. conduits
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head	EA LF EA LF EA EA EA EA	10 3110 50 1 1000 1 1 1 1 0 2	\$ 6 \$ 5 \$ 1 \$ 5 \$ 5 \$ 1 \$ 1 \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 450.00 1,000.00 1,000.00 500.00	\$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 5,300.00 450.00 15,000.00 - 2,000.00 3,000.00	All purposes
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable	EA LF LF EA LF EA EA EA EA	10 3110 50 1 1000 1 1 1 1 0	\$ 6 \$ \$ \$ 1 \$ 5 \$ 5 \$ 1 \$ 5 \$ 1	300.00 6.00 14.00 1,500.00 5.00 4,000.00 450.00 4,000.00 1,000.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 5,300.00 450.00 15,000.00 - 2,000.00 3,000.00 3,811.50	All purposes One ramp crossing, mult. conduits
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head	EA LF EA LF EA EA EA EA	10 3110 50 1 1000 1 1 1 1 0 2	\$ 6 \$ 5 \$ 1 \$ 5 \$ 5 \$ 1 \$ 1 \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 450.00 1,000.00 1,000.00 500.00	\$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 5,300.00 450.00 15,000.00 - 2,000.00 3,000.00	All purposes One ramp crossing, mult. conduits
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal	EA LF EA LF EA EA EA EA	10 3110 50 1 1000 1 1 1 1 0 2	\$ 6 \$ 5 \$ 1 \$ 5 \$ 5 \$ 1 \$ 1 \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 450.00 1,000.00 1,000.00 500.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 5,300.00 450.00 15,000.00 - 2,000.00 3,000.00 3,811.50	All purposes One ramp crossing, mult. conduits
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications	EA LF LF EA EA EA EA EA EA	10 3110 50 1 1000 1 1 1 1 0 2 6 1386	\$ 6 \$ 5 \$ 5 \$ 1 \$ 5 \$ 5 \$ 1 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5	300.00 6.00 14.00 5.00 4,000.00 5,300.00 450.00 5,000.00 1,000.00 500.00 2.75	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 450.00 15,000.00 - 2,000.00 3,000.00 3,811.50	All purposes One ramp crossing, mult. conduits Ramp meter advance signal
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications	EA LF LF EA EA EA EA EA EA	10 3110 50 1 1000 1 1 1 0 2 6 1386	\$ 6 \$ \$ \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 450.00 1,000.00 1,000.00 2.75	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 450.00 15,000.00 - 2,000.00 3,000.00 3,811.50 84,751.50	All purposes One ramp crossing, mult. conduits Ramp meter advance signal Link to MVDS
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure	EA LF LF EA EA EA EA EA EA	10 3110 50 1 1000 1 1 1 0 2 6 1386	\$ 6 \$ \$ \$ \$ \$ 1 \$ \$ \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 5,300.00 1,000.00 2.75 2.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 450.00 15,000.00 - 2,000.00 3,000.00 3,811.50 84,751.50 700.00 1,000.00	All purposes One ramp crossing, mult. conduits Ramp meter advance signal Link to MVDS Link to SMFO
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure Pullbox (Special Size)	EA LF LF EA EA EA EA EA EA EA	10 3110 50 1 1000 1 1 1 0 2 6 1386	\$ 6 \$ \$ \$ \$ \$ 12 \$ 5 \$ 5 \$ 15 \$ 1 \$ 1 \$ 5 \$ 1 \$ 1 \$ 5 \$ 1 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 5,300.00 1,000.00 1,000.00 2.75 2.00 1,000.00 1,750.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 450.00 15,000.00 - 2,000.00 3,000.00 3,811.50 84,751.50 700.00 1,000.00 1,750.00	All purposes One ramp crossing, mult. conduits Ramp meter advance signal Link to MVDS Link to SMFO For splice enclosure
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure	EA LF LF EA EA EA EA EA EA EA EA	10 3110 50 1 1000 1 1 1 0 2 6 1386	\$ 6 \$ \$ \$ \$ \$ 12 \$ 5 \$ 5 \$ 15 \$ 1 \$ 1 \$ 5 \$ 1 \$ 1 \$ 5 \$ 1 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 5,300.00 1,000.00 2.75 2.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 450.00 15,000.00 - 2,000.00 3,000.00 3,811.50 84,751.50 700.00 1,000.00 1,750.00	All purposes One ramp crossing, mult. conduits Ramp meter advance signal Link to MVDS Link to SMFO
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure Pullbox (Special Size)	EA LF LF EA EA EA EA EA EA EA	10 3110 50 1 1000 1 1 1 0 2 6 1386	\$ 6 \$ \$ \$ \$ \$ 12 \$ 5 \$ 5 \$ 15 \$ 1 \$ 5 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 5 \$ 1 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 5,000.00 1,000.00 2.75 2.00 1,000.00 1,750.00 1,500.00 1,500.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 450.00 15,000.00 - 2,000.00 3,000.00 3,811.50 84,751.50 700.00 1,000.00 1,750.00 1,500.00 750.00	All purposes One ramp crossing, mult. conduits Ramp meter advance signal Link to MVDS Link to SMFO For splice enclosure
Pullbox (Std.) Conduit (Trenched) Conduit (Directional Drilled) Electrical Service Electrical Conductors 2070 Controller and Cabinet Firmware/Calibration Cabinet Foundation 45' Mast Arm Poles and Foundation Pedestal Pole Three Section Signal Head One Section Signal Head Signal Cable Subtotal Communications Serial Communications Splice Enclosure Pullbox (Special Size) Interconnect Center	EA LF LF EA EA EA EA EA EA EA EA	10 3110 50 1 1000 1 1 1 0 2 6 1386	\$ 6 \$ \$ \$ \$ \$ 12 \$ 5 \$ 5 \$ 15 \$ 1 \$ 5 \$ 5 \$ 1 \$ 5 \$ 1 \$ 5 \$ 5 \$ 1 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5 \$ 5	300.00 6.00 14.00 1,500.00 5.00 4,000.00 6,300.00 450.00 1,000.00 2.75 2.00 1,000.00 1,750.00 1,500.00	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3,000.00 18,660.00 700.00 1,500.00 5,000.00 14,000.00 450.00 15,000.00 2,000.00 3,000.00 3,811.50 84,751.50 700.00 1,750.00 1,500.00	All purposes One ramp crossing, mult. conduits Ramp meter advance signal Link to MVDS Link to SMFO For splice enclosure In cabinet

Pavement Marking							
1 averneric Marking			1				To narrow lanes, 50 MPH design
							speed, maintain one edge line, pave
Pavement Marking Removal	LF		\$	0.62	\$	_	over other edge line
Raised Pavement Markers	EA	3	\$	4.50		13.50	· · ·
Transcar arement manners			1		Ť		200' transitions, 100' narrowed lane,
White Edge Line	LF	600	\$	0.95	\$	570.00	50 MPH
							300' transitions, 100' narrowed lane,
Yellow Edge Line	LF	600	\$	0.95	\$	570.00	50 MPH
24" Stop Bar	LF	24	\$	7.00	\$	168.00	
White Skip Line	LF	200	\$	0.24	\$	47.50	
Subtotal					\$	1,369.00	
				!			•
Signing							
W3-8, Ramp Metered When Flashing	EA	2	\$	650.00	\$	1,300.00	Sign and post only
W3-4, Be Prepared to Stop	EA	1	\$	650.00	\$		Sign and post
R10-6, Stop Here on Red	EA	1	\$	175.00	\$	175.00	Pedestal mounted
R10-28, XX Vehicles Per Green	EA	1	\$	175.00		175.00	Pedestal mounted
W4-1L, Merge Left	EA	2	\$	650.00		1,300.00	
Sign Structure (Cantilever)	EA	2	\$50	0,000.00		100,000.00	
Ramp Meter On Sign (Message A)	EA	1		5,000.00		5,000.00	
Prepare to Stop Sign (Message B)	EA	1	\$ 5	5,000.00	_	5,000.00	
Subtotal						113,600.00	
Subtotal Construction (Rounded)						259,930.00	
Traffic Control				3%	\$	8,000.00	
Contingencies				10%	\$	26,000.00	
Total Construction (Rounded)			\$	293,930.00			
							•
Design				8%	\$	24,000.00	
Construction Administration				10%	\$	30,000.00	
Total Design and Construction					\$	347,930.00	

 Table 16.
 Detailed Typical Optional Enforcement Features Construction Costs

Categories	Description	Unit	Quantity	Uı	nit Cost	Т	otal Cost	Assumptions
Earthwork and	•							•
Retaining W		LF	0	\$	250.00	\$	-	
Retaining W		LF	0	\$	475.00		-	
Subtotal	<u> </u>					\$	-	
					'			•
Guardrail								
Guardrail Ra		LF	0	\$	15.00	\$	-	
	proach End Treatment	EA	0	\$	1,500.00	_	-	
Subtotal						\$	-	
Б.								
Paving Excavation		CY	0	\$	4.00	\$		
Fill		CY	188	\$	5.00		940.00	
1 111			100	Ψ	0.00	۳	0 10.00	Seeding along edge of
Seeding		SY	25	\$	2.50	\$	62.50	pavement
Subtotal						\$	1,002.50	
							, 	
Paving								
Ramp Wide	ning	SY	188	\$	32.00	\$	6,016.00	
Pavement R	esurfacing	SY	0	\$	12.00	\$	-	
Subtotal						\$	6,016.00	
								<u> </u>
Signalization								
One Section	Signal Head	EΑ	1	\$	500.00		500.00	
Signal Cable	e	LF	10	\$	2.75		27.50	Enforcement signal
Subtotal						\$	527.50	
Pavement Marl			1					
	ement Markers	EA	0	\$	4.50		-	
White Edge	Line	LF	330	\$	0.95		313.50	
Subtotal						\$	313.50	
Signing				^	050.00		050.00	lo:
Enforcement	t Area Sign	EA	1	\$	650.00	\$	650.00	Sign and post only
Subtotal						\$	650.00	
	struction (Rounded)		-			\$	8,510.00	
Traffic Contr					3%	\$	1,000.00	
Contingencie					10%	\$	1,000.00	
Total Constru	ction (Rounded)					\$	10,510.00	
Design					8%	\$	1,000.00	
Construction A	dministration				10%	\$	2,000.00	
					10/0		13,510.00	
ı otai Design a	and Construction					Þ	13,510.00	

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